

## ATTREX Science Flight Report

### 2013-02-05 Science Flight #1

#### Pilots:

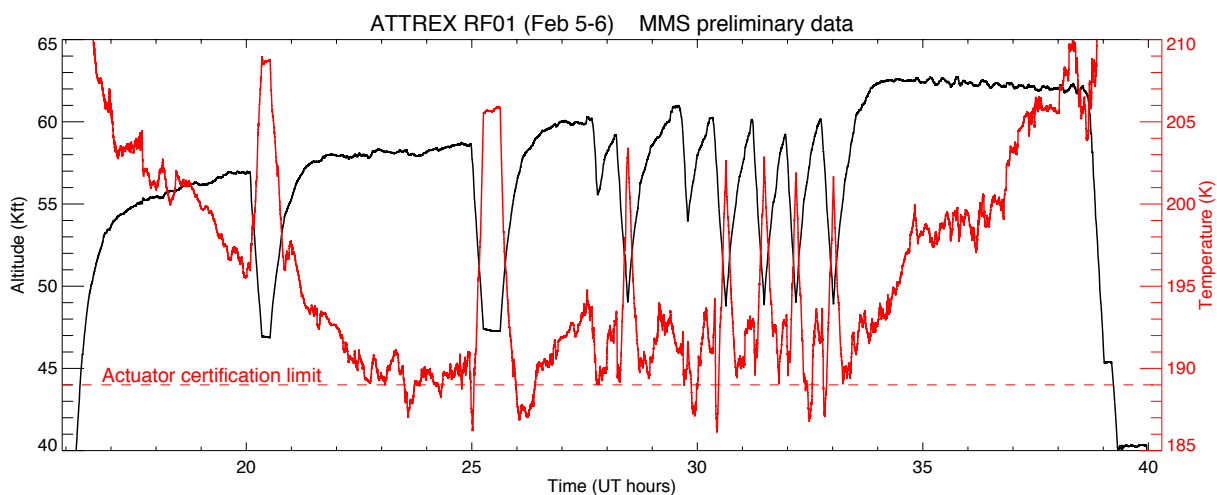
**Mission Scientists:** Paul Newman, Eric Jensen, Hanwant Singh

**Payload Managers:** Dave Jordan, Dave Fratello

#### Summary:

This flight provided several profiles in the tropics and subtropics, including multiple passes through air colder than 189 K. Extremely dry air was sampled in the upper TTL. The combination of satellite measurements and in situ data collected on this flight should allow evaluation of the dehydration occurring during the anomalously cold tropical tropopause conditions that prevailed during January 2013. Ice clouds were detected in the lower TTL, but not in the upper TTL associated with the very dry layers. The southernmost legs extended down to about 12.5 N between about 144 and 150 W.

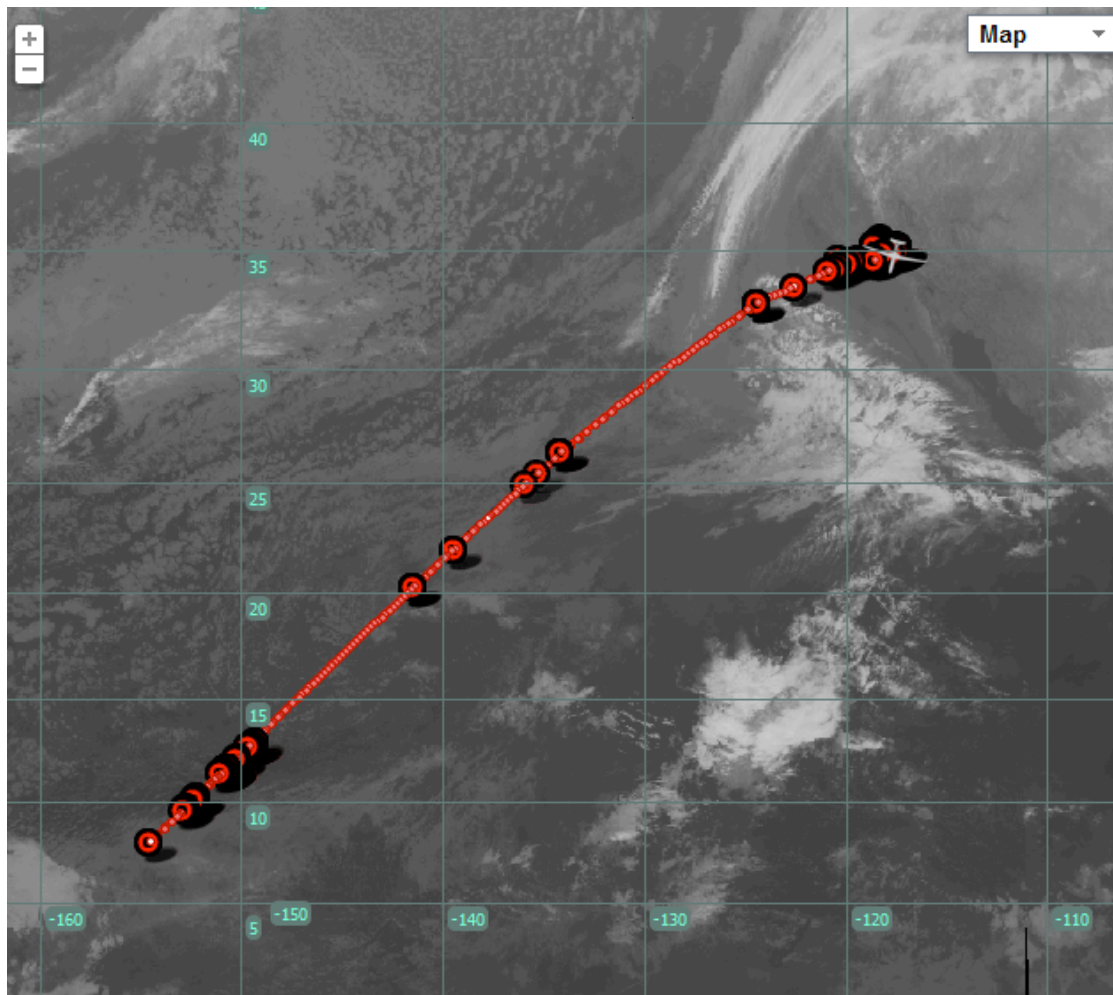
The altitude and temperature time series (preliminary data from MMS) for the flight are shown below. We dipped below the actuator certification temperature multiple times. A preliminary look at temperature measurements made in the spoiler bays confirm the expectation that the environment surrounding the actuators remained considerably warmer than the outside total air temperature.



#### Timeline:

1345 GHOC staffed

1400 Some problems with radio communication with VTC at the Global Hawk



1410 Still waiting to resolve communication issues. Component needed from GHMOF. 15 minute hold.

1421 Engine start

1431 Begin turn-on of EIPs

1453 Still no pin-pull. Problems with re-keying the aircraft.

1507 Met folk in Lakebed Conference Room report that forecasts have changed in only a minor way, so that we should stay with our current plan.

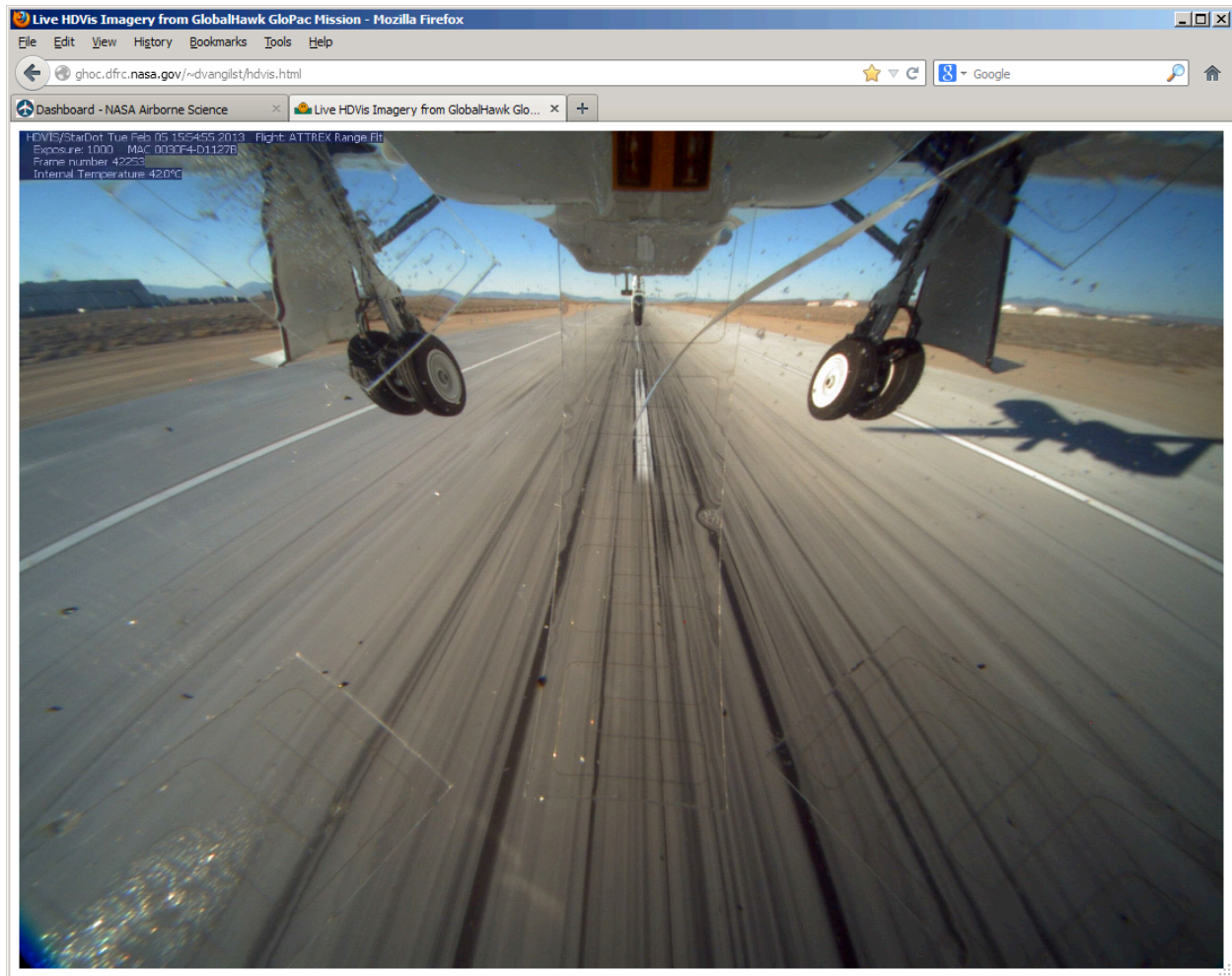
1534 Key problem solved. Payload coming up.

1539 Pin pulled

1544 Ready for taxi

1547 Ready for takeoff

1555 Takeoff



1558 Because of the late takoff, we will skip the MMS maneuver on range and proceed directly to DINTY after reaching FL450.

1609 Some problems with Iridium.

1620 Status: UCAT & UCATS O3 good, DLH some problems with status packets, NOAA O3 & H2O good, MTP good, mini-DOAS good, FCDP good, Harvard is good, CPL good (waiting to transmit), MMS is good, GWAS is good (already took 5 samples), SSFR is good.

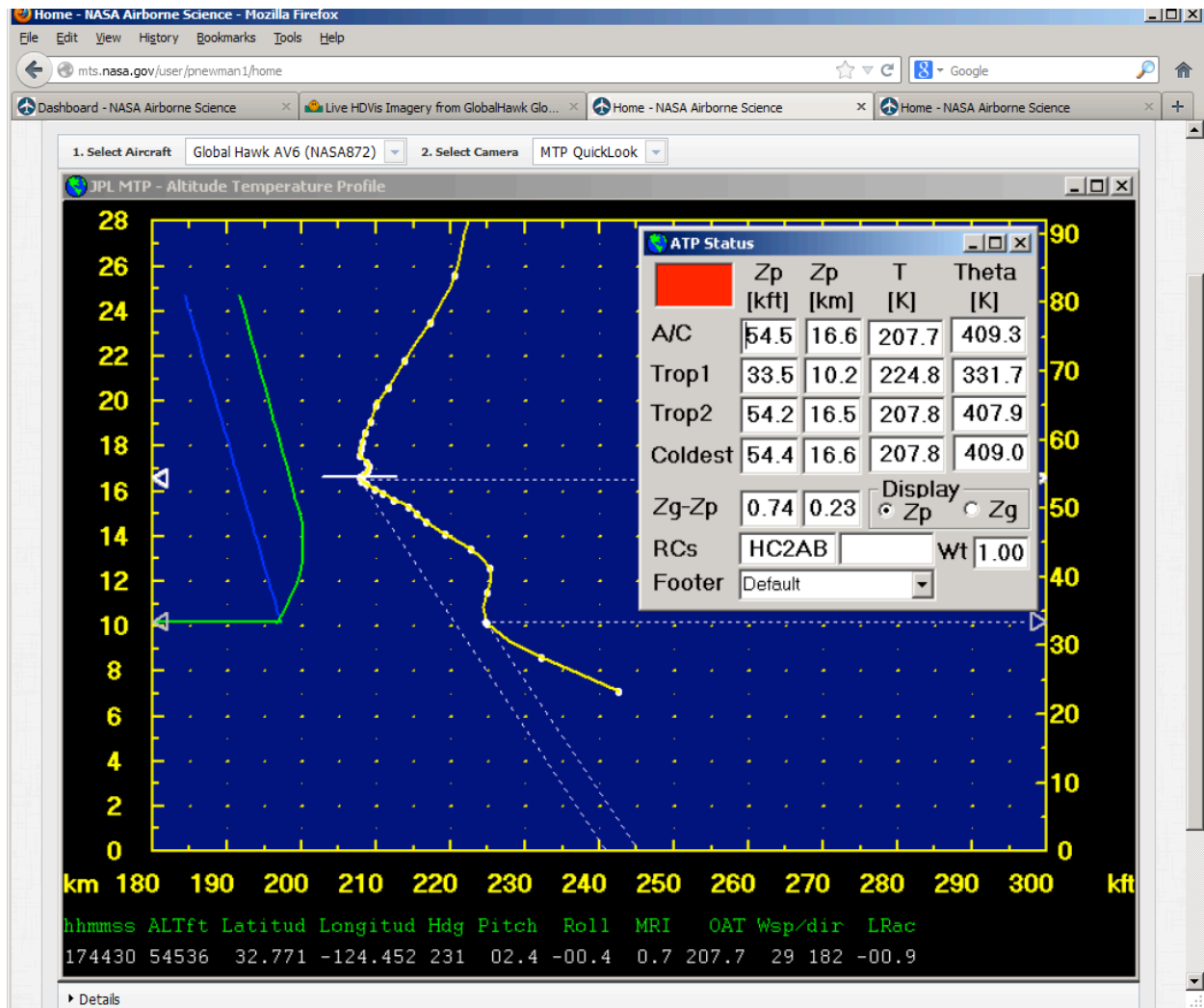
1651 GWAS got a good set of cans from 42,000 every 2000 feet up to 50,000 ft.

1657 Feet wet over the Pacific.

1730 Preparing to turn on CPL

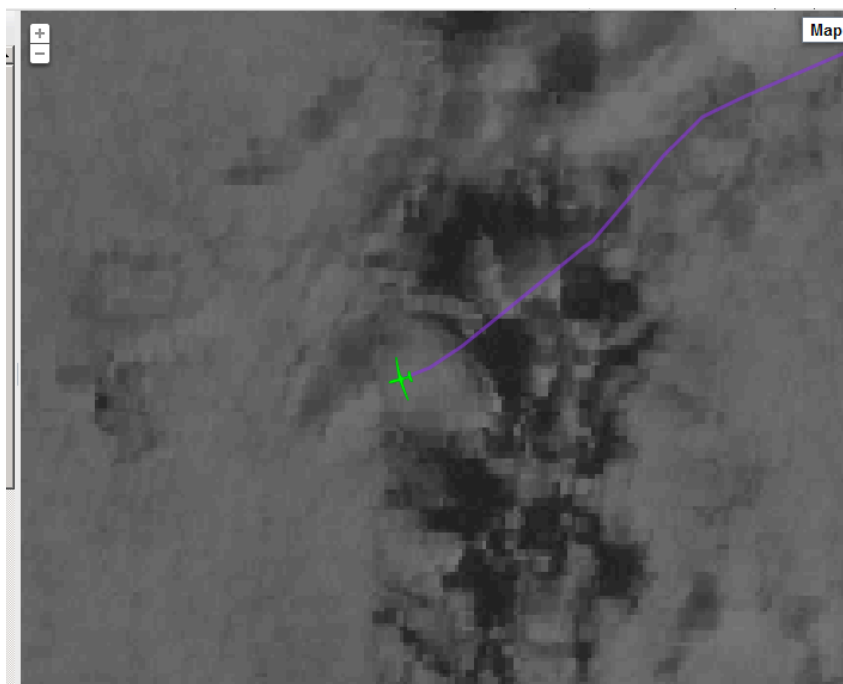
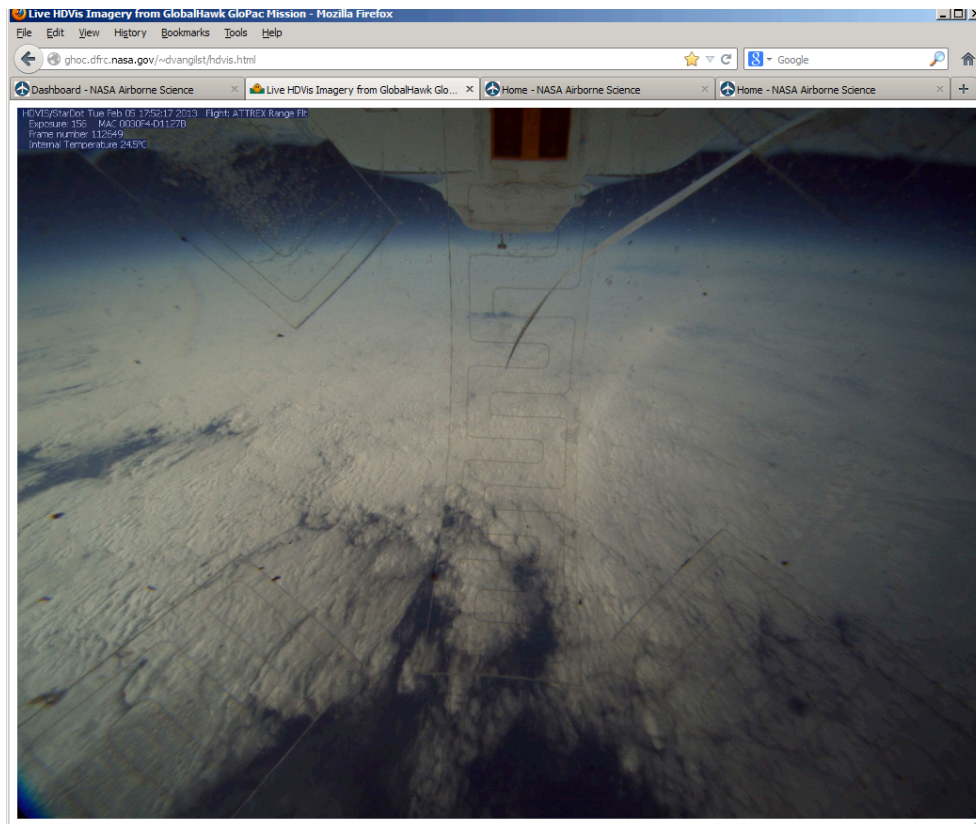
1734 MTP quick look not working.

1746 MTP display is on line:



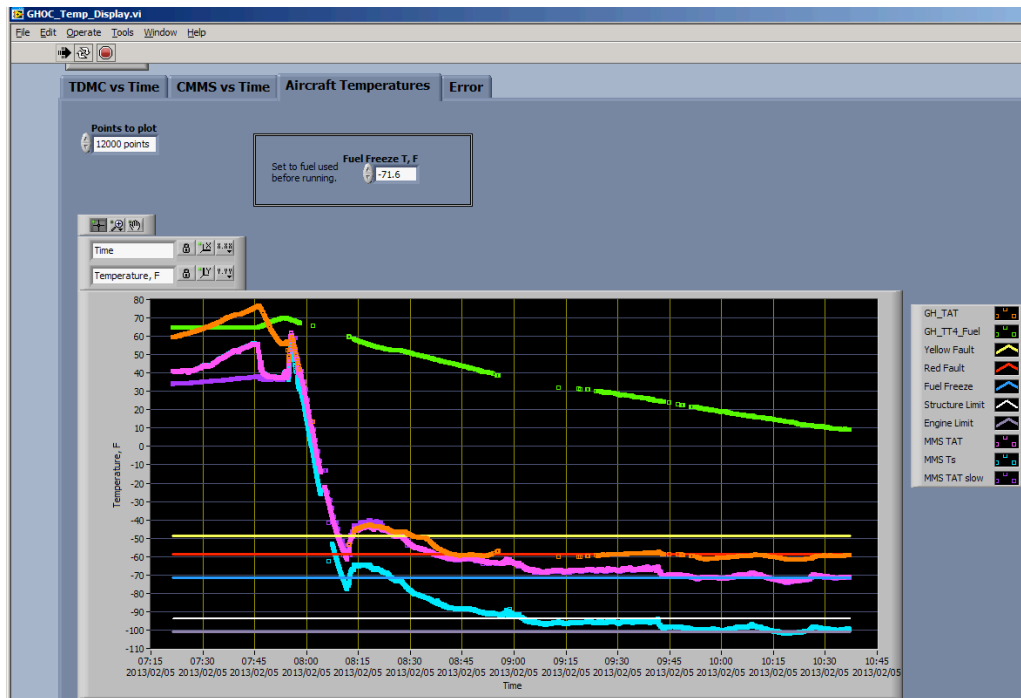
Note the interesting “double” tropopause structure. Aircraft is currently near the cold point, at about 208K.

1752 CPL turned on.



1750 HDVis view of low level stratus and  
1837 Temperatures slowly decreasing





1854

1. NOAA WVR: running both cells. Pump is a bit high, so will need post flight calibration.
2. NOAA O3: working well. Brief outage
3. UCATS : N2O, CH4 working well. Both ozones working. Water working well too.
4. MTP: MTP good.
5. DLH: working well.
6. Mini DOAS: Some problems with one of the telescopes, but everything working fine now.
7. FCDP: Looks good. Waiting for clouds.
8. HU/PCRS: Doing OK. Couple of little issues. Need to get into a low flow mode. Should be able to do that on the dip.
9. CPL: Working well. Good strong signals. No images on MTS
10. MMS: Pretty good. GPS signal dropped sometimes.
11. GWAS: Doing great. 14 samples.
12. SSFR: Instrument running fine.

1914 CPL images are getting onto MTS now

1915 Eric Jensen takes over from Paul Newman

2005 Begin first descent to FL450

2009 MTP cold point has been relatively high (58-60 Kft)

1218 Cold point descending as we head SW

1221 Level at FL450, powering on GWAS and KU.

1231 Climb back to cruise initiated.

1252 23.3 N lat, cold point back up at ~60 kft.

2110 Brief swap-out of mission scientists: Newman for Jensen .

2120 Instrument Poll

1. NOAA WVR: Still working well.
2. NOAA O3: working well. No outages since last report.
3. UCATS : Everything still working well.
4. MTP: MTP good. MTP images are being updated infrequently on MTS.
5. DLH: working well.
6. Mini DOAS: Working well. Will do a calibration at about 16N.
7. FCDP: Still good & still waiting for clouds.
8. HU/PCRS: Back where they want to be and flight should be fine.
9. CPL: Working well. Good strong signals. Images on MTS now.
10. MMS: Very good.
11. GWAS: Doing great. 27 samples.
12. SSFR: Everything fine.

2137 HDVIS showing a very large crack across the glass housing. This crack was first seen not long after takeoff and has been getting progressively worse.

2155 Met room estimates that we'll see -94F TAT at about 14.5N.

2207 MTP seems to have a warm bias of ~ 6 K

2213 MJ says the reason for the MTP bias is that they are using the aircraft temperature

2216 MMS TAT at -92 F, aircraft at 56.7 Kft (about 1 Kft below cold point)

2218 Need to futz with color scale on MTP cold point display on MTS map

2229 A/C at 56.9 Kft, just above the cold point, TAT wiggling around -91 to -92 F

2230 Amplitude of temperature wave in MMS is ~1 K

2232 H2O (NOAA and DLH) has been in the 2-2.5 ppmv range

2235 Plan in front room is to go about 0.5 F beyond -94 before starting 10-min timer

2237 TAT dipped below -94 F briefly.

2244 At TAT=-94.5 F, MD started the 10-min timer

2247 TAT warmed up, so MD decided to reset the timer

2250 We are now just above the narrow cold point

2301 TAT has been staying around -93.5 F

2304 TAT dropped below -94.5 again, and MD started the timer

2308 TAT warmed up again, so MD decided to continue SW

2325 Still riding just above the cold point

2330 Dropped below -95 and MD started timer again

2331 Cold point a bit higher now

2334 Started turn back NE

2335 TAT dropped below -98 F

2336 Cold point at aircraft altitude (57 Kft)

2348 Cold exposure was about 14 min; we're going heading NE to warm for ~30 min.

2356 Instrument Poll

1. NOAA WVR: Still working well.

2. NOAA O3: working well. Pressure transducer noisy. Not a problem after flight.
3. UCATS : Everything still working well.
4. MTP: MTP good. MTP images are being updated infrequently on MTS.
5. DLH: working well.
6. Mini DOAS: Working well. Will do a calibration at about 16N.
7. FCDP: Still good & still waiting for clouds.
8. HU/PCRS: Back where they want to be and flight should be fine.
9. CPL: Working well. Good strong signals. Images on MTS now.
10. MMS: Very good.
11. GWAS: Doing great. 27 samples.
12. SSFR: Everything fine.

0012 Turning around back to sw to head back to cold temperatures

0018 Heading back to cold temperatures (towards the SW, MMS TAT is -95.6).

0021 MMS TAT back up to -93.9 – still heading SW – We have mesoscale and microscale fluctuations that are perturbing the basic gradient (decreasing temperatures as we head southwest). MD estimate about 15 minutes to the dive.

0030 Temperatures are near constant (tat of -93.5) as we cruise climb. MTP shows we are above the cold point, and this is quite reliable.

0034 Still heading SW into the colder air but tat holding at -93.5

0045 We are starting preparations for the 2<sup>nd</sup> dive, TAT is -93. or so, still heading SW. GWAS turn off

0046 We are close to -94 now. Starting turn off of CPL.

0048 Blow by blow, temps going back up to -93

0048 Note that TAS is higher than our usual calculations. Static temp (MMS) IS 188.5 (BELOW NOMINAL STRUCTURE LIMIT) WHILE tat IS -92.5.

0123 GWAS PUMP SEEMS TO HAVE FAILED. No samples for remainder of flight

0125 Turning back NE

0139 Climbing back through cold layer

0147 NOAA total-vapor H2O indicated condensed water on climb through about 140-120 mbar

0158 Water vapor as low as 1.67 ppmv at ~54.7 kft

0222 Temperature stayed below -94 F longer than 20 min heading NE (about 26 min)

0226 Heading NE to warm up for at least 50 min

0255 Pilots are negotiating plan to head due south at 145 W when we come back on the SW leg

0309 Turning back SW

0316 Heading S at 144 W

0335 A/C reached 59.5 kft; executed descent to stay below 60 kft

0349 Climbing back up from about 54 kft; water below 2 ppmv again

0400 turning north; plan is to descend heading north

0404 No MTP for past half hour

0405 MTP is back

0411 Descending to 45 kft

0423 TT4 down to -43.5

0427 Climbing from 47 kft



0450 DLH water down to 1.57 ppmv on climb

0456 Turning back south. z=57 kft

0528 Climbed above 60 kft suddenly

0538 S-turn to drop below 60 and execute descent

0549 Climbing back up from 53 kft

0603 Dropped below -94F for about 8 min in climb

0610 Cold layer below aircraft

0618 Turned back north

0619 Descending to stay below 60 kft

0624 Instrument Poll

1. NOAA WVR: Still working well.
2. NOAA O3: working well. Pressure transducer noisy. Not a problem after flight.
3. UCATS : Everything still working well.
4. MTP: MTP good. MTP images are being updated infrequently on MTS.
5. DLH: working well.
6. Mini DOAS: Working well. Will do a calibration at about 16N.
7. FCDP: Still good & still waiting for clouds.
8. HU/PCRS: Back where they want to be and flight should be fine.
9. CPL: Working well. Good strong signals. Images on MTS now.
10. MMS: Very good.
11. GWAS: Pump down
12. SSFR: Everything fine.

0628 TAT down to ~-100 F

0637 Climbing back up

0710 reached 58 Kft start descent (going north)

0725 Extremely dry 1.1-1.3 ppm lowest at tropopause

0728 start climb from 47 Kft at 17.4N (200K); 0734 @18.1N & 50Kft turning south; coldest at about 56Kft

0756 Climbed to 58Kft @ 16.3N; O3-214 ppb; ready for descent

0811 At 47Kft @15.1N; start climb (driest air is associated with low O3 (30-40 ppb) i. e. trop air)

0835 Approaching E. L. at 57 Kft; climb to 58Kft at 13N

0845 Start descent heading North at 12.5N

0900 Descent to 47Kft @14.1 N; climb to go home

0940 60+ kFT at 17.5N; cruising home

1100 Multiple instrument data on O3, CH4 looks good. NOAA water vapor seems about 20% higher than DLH

1110 All instruments working normally except GWAS

1151 62Kft; O3-1000 ppb, 21.6N

1237 Some cirrus in the area at around 10 km

1250 periodic large wave structure in O3 & a small one in H2O

1326 32.3N; 62Kft-O3 around 1500 ppb; CH4-1.6 ppm

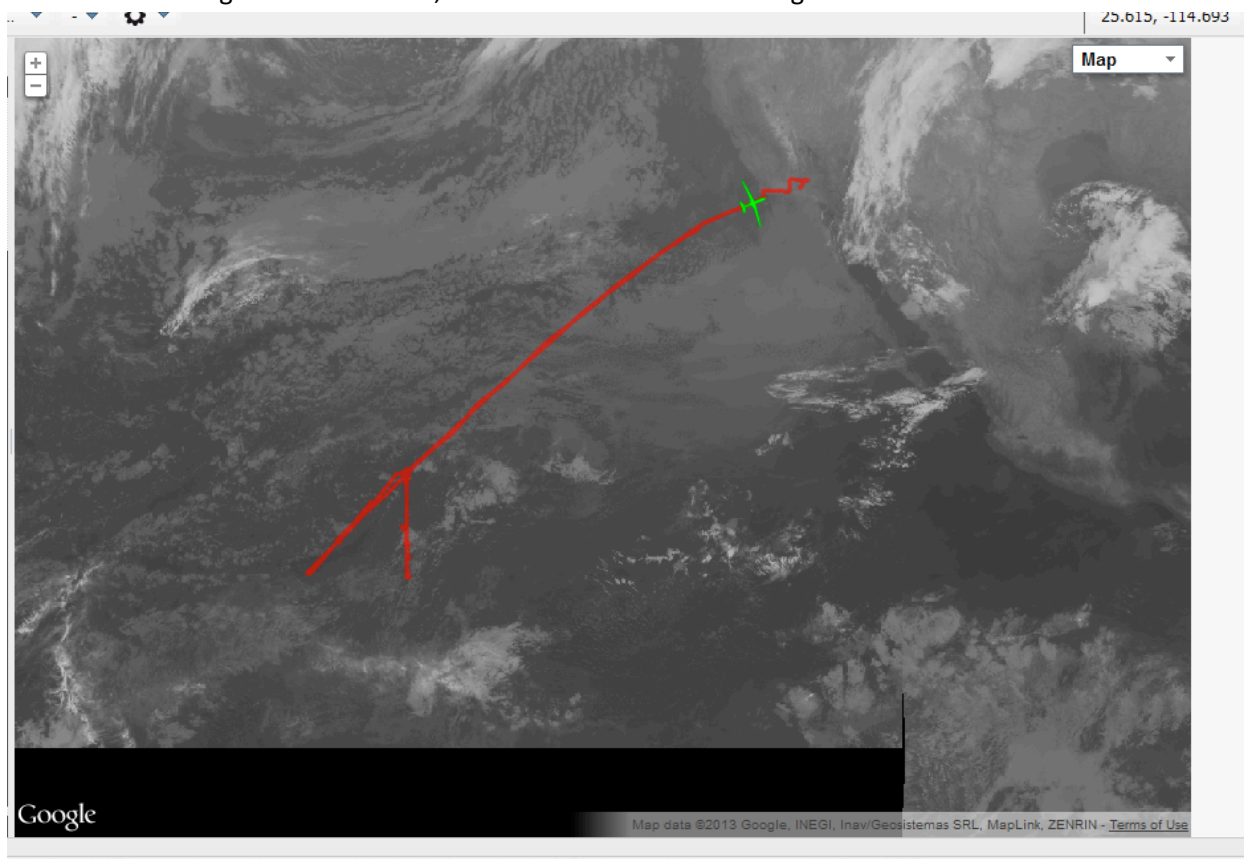
1345 Paul Newman relieves Hanwant Singh as mission scientist

1348 Sonde launch scheduled for 1430 Launch at Edwards

1357 Instrument Poll

1. NOAA WVR: Still working well. Flow rate appears to be low.
2. NOAA O3: working well. Still has pressure transducer noise.
3. UCATS : Everything still working well.
4. MTP: MTP good.
5. DLH: working well.
6. Mini DOAS: No photons.
7. FCDP: Still good & still waiting for clouds.
8. HU/PCRS: Fine.
9. CPL: Working well. Saw a bit of cirrus today.
10. MMS: Very good.
11. GWAS: Pump down
12. SSFR: Everything fine. No photons.

1405 GOES IR image. Low level stuff, but little cirrus over entire flight at altitude



1414 Feet dry

1420 Payload power down begins

1426 payload off

1436 Descent into range begins From FL620 to FL450.

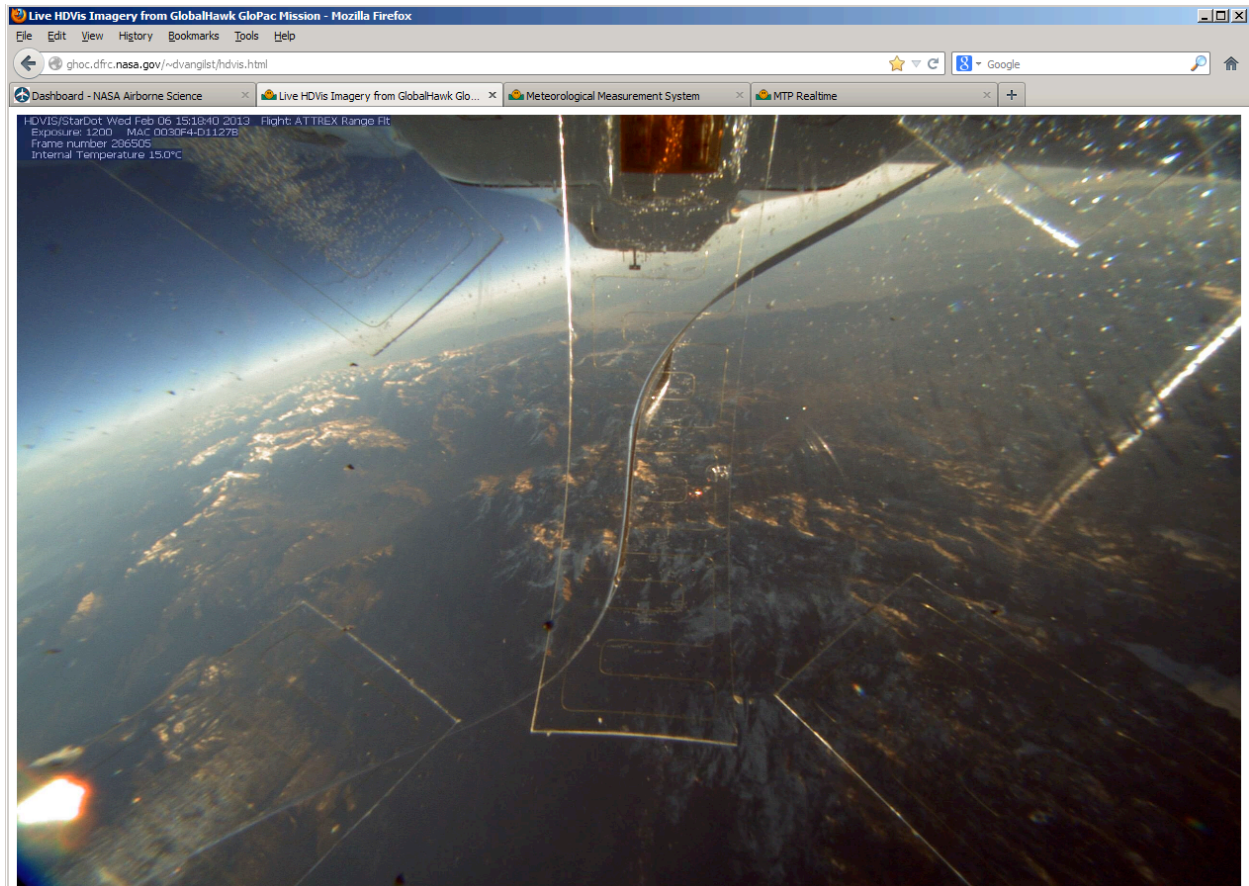
1452 Slow descent, since spoilers are not deployed. @FL520

1502 reached FL450. Payload being powered up.

1508 Powered up

1509 Beginning mms maneuvers.

1519 HDVIS image during MMS maneuver over Sequoia National Forest. Note crack across HDVIS cover.



1521 MMS pitch maneuver

1600 Starting descent to landing from FL400

1618 Instruments all powered down

1626 Landed